Mississippi State UNIVERSITY

Center for Air Sea Technology

1995 STUDENT RESEARCH PROJECTS

Technical Note 01-95
30 September 1995

Prepared Under Office of Naval Research Grants N00014-95-1-0186, N00014-95-1-0218, N00014-95-1-0293, and N00014-95-1-0303; Office of Naval Research Grant N00014-95-1-0068 and Subcontract to the University of Southern Mississippi USM-02282251110-A10; Naval Research Laboratory Contract N00014-92-C-6032 and NASA Contract NAS13-564 Delivery Order 11 with the Naval Oceanographic Office

Approved for public release; distribution is unlimited.
Mississippi State University Center for Air Sea Technology
Stennis Space Center, MS 39529-6000

MISSISSIPPI STATE UNIVERSITY
CENTER FOR AIR SEA TECHNOLOGY

FY1995
STUDENT RESEARCH PROJECTS

BUILDING 1103-ROOM 233

STENNIS SPACE CENTER, MS 39529-6000

Accesion For	
NTIS CRA&I	☒
DTIC TAB	☐
Unannounced	☐
Justification ________	
By ________	
Distribution /	
Availability Codes	
Dist	Avail and / or Special
A-1	

Compiled and Edited by
Lanny A. Yeske

This research was supported by the Department of the Navy Under Office of Naval Research Grants N00014-95-1-0186, N00014-95-1-0218, N00014-95-1-0293, and N00014-95-1-0303; Office of Naval Research Grant N00014-95-1-0068 and Subcontract to the University of Southern Mississippi USM-02282251110-A10; Naval Research Laboratory Contract N00014-92-C-6032, and NASA Contract NAS13-564 Delivery Order 11 with the Naval Oceanographic Office. The Opinions, Findings, Conclusions, and Recommendations expressed in this Pulbication are those of the Authors and do not necessarily reflect the views of the U.S. Government or the University of Southern Mississippi. No official endorsement should be inferred.

FOREWORD

The Center for Air Sea Technology (CAST) research program in FY95 was modified to adjust to new Navy Ocean Modeling and Prediction (NOMP) program priorities, especially in the area of coastal and semi-enclosed seas. The objectives were to:

- Conduct coastal and semi-enclosed seas ocean modeling basic research, embedded in a CAST modularized software system, with the emphasis on model relocatability to any geographical region;

- Support the technical requirements of Navy and university ocean modeling efforts by providing routine day-to-day technical support to the scientific staff, and by designing, developing, and implementing next generation technical support capability;

- Tailor and transition applicable advanced technical support capabilities developed for the research community to the operational Navy; and

- Strengthen collaboration with academia by incorporating student and faculty in CAST projects.

In accomplishing these objectives, CAST in FY1995 supported 11 graduate and undergraduate students, which included two through the MSU Cooperative Education Program, one from the MSU NSF-sponsored Engineering Research Center, four through the University of Southern Mississippi Cooperative Education Program, three from William Carey College, and one from Oregon State University. CAST also had a faculty program with research affiliates from the Tulane University Department of Computer Science, and the MSU-NSF Engineering Research Center.

This technical note summarizes the FY1995 research conducted by these students and research affiliates. CAST was extremely pleased with the research support provided by these individuals, not only in their dedication but in the quality of the research conducted.

J.H. CORBIN
Director

TABLE OF CONTENTS

Page

TABLE OF CONTENTS (Continued)

Page

Alberto Mestas-Nunez
Ph.D. Program, Orgeon State University and
Graduate Research Assistant, Mississippi State University

Project Title: Large-Scale Variability of Sea Level and Wind Forcing in the South Pacific

Objective: The objective was to study the large-scale variability of sea level in the South Pacific Ocean ant its relation to wind forcing using 23 months (December 1986 to October 1988) of Geosat altimeter observations. A secondary objective was to compare the sea level variability observed by Geosat with the results of simulations from three ocean models.

Approach: The spatial and temporal characteristics of the large-scale sea level variability observed by the Geosat altimeter are described efficiently using Empirical Orthogonal Function (EOF) analysis. The physical mechanisms are investigated by comparing the dominant modes of the observed sea level variability with the corresponding modes of variability of wind stress curl forcing and of sea level from three ocean models. The models are a simple Sverdrup (Mestas-Nunez et al, 1992), a global hydrodynamic version of the Naval Research Laboratory (NRL) layered (Wallcraft, 1991), and the global Semtner and Chervin z-level (SC). The models are all forced by wind stresses based on ECMWF analyses. The SC model also includes heat and salt fluxes modeled by simple restoring to Levitus climatology in the uppermost level. The NRL model has six layers and a resolution of 0.35° longitude by 0.5° latitude. The SC model is a 20-level free-surface version of the Bryan-Cox-Semtner model following Killworth et al (1991) and has a resolution of 0.4° longitude and 0.25° (average) latitude.

Results: It was shown that Geosat sea level and wind stress curl present similar distributions of variance with EOF mode number. In both fields the variance was spread over a large number of modes, illustrating the complicated nature of sea level and curl variability at mid latitudes in the South Pacific. These results are consistent with EOF analysis of sea level in the Southern Ocean (Chelton et al, 1990) and of wind stress curl in the North Atlantic (Ehret and O'Brien, 1989). Among the models considered in this study, Sverdrup produced the distribution of variance that differed the most, and SC the distribution that was closer to the distribution of Geosat.

These results are encouraging because the models are organized in a sequence that follows the degree of realism that they represent. While all the models are wind driven, the Sverdrup model is barotropic with flat bottom and does not contemplate transient motions. The NRL model has stratification with topography and allows transient motions associated with the barotropic as well as the first 5 baroclinic modes. Finally, the SC model adds stratification with greater vertical resolution and thermal forcing. However, none of the variance distributions from the models compares well with Geosat, illustrating the shortcomings of these models in describing the observed variance spectrum of sea level variability.

The first EOF of Geosat sea level shows a zonally coherent basin-scale oscillation which is significantly correlated with the first EOF of the wind stress curl and of sea level from the models. Since all the models are wind forced, the analysis supports an interpretation of this mode as a response of the South Pacific to seasonal changes in the wind forcing. However, seasonal thermal heating and cooling cannot be ruled out because the results of the SC model (which also includes thermal forcing) compare better with Geosat than the results of the purely wind driven models.

Future Research Recommendations: At present, high quality sea level observations from the TOPEX/POSEIDON altimeter (Fu et al, 1994) as well as high resolution global simulations from numerical models (e.g., Smith et al, 1995) are becoming available. The results of this study can be compared with the TOPEX/POSEIDON data and with the improved simulations.

References

Chelton, D.B., M.G. Schlax, D.L. Witter, and J.G. Richman (1990). Geosat Altimeter Observations of the Surface Circulation of the Southern Ocean. J. Geophys. Res., Vol 95, 17,877-17,903.

Smith, R.D., R.C. Malone, M. Maltrud and A.J. Semtner (1995). Global Eddy-Resolving Ocean Simulations Driven by 1985-1995 Atmospheric Fields. (Submitted to J. Geophys. Res.)

Ehret, L.L., and J.J. O'Brien (1989). Scales of North Atlantic Wind Stress Curl determined from the Comprehensive Ocean-Atmosphere Data Set. J. Geophys. Res., Vol 94, 831-841.

Fu, L.-L., E.J. Christensen, C. Yamarone, M. Lefebvre, Y. Menard, M. Dorrer, and P. Escudier (1994). TOPEX/POSEIDON Mission Overview. J. Geophys. Res., Vol 99, 24369-24381.

Killworth, P.D., D. Stainforth, D.J. Webb, and S.M. Paterson (1991). The Development of a Free-Surface Bryan-Cox-Semtner Ocean Model. J. Phys. Oceanogr., Vol 21, 1333-1348.

Mestas-Nunez, A.M., D.B. Chelton, and R.A. DeSzoeke (1992). Evidence of Time-Dependent Sverdrup Circulation in the South Pacific from the Seasat Scatterometer and Altimeter. J. Phys. Oceanogr., Vol 22, 934-943.

Wallcraft, A.J. (1991). The Navy Layered Ocean Model Users Guide. Naval Oceanographic and Atmospheric Research Laboratory Report 35, 21 pp.

Research Advisor: Dr. David Dietrich, Mississippi State University

Clifton Abbott
B. S. Program, MSU Cooperative Education Program
Mississippi State University

Project #1 Title: CAST Model Evaluation System on Integrated Stored Information System (ISIS) Database (CMESisis) DbaTools

Objectives: To design interfaces for the dba add and browse tools for the CMESisis.

Approach: The first step in designing the dba interfaces is to determine which dba tools are to be provided to the user. Then one needs to determine which attributes are going to be displayed and which attributes are going to be entered by the user for each tool. The next step is to position each attribute or item on the screen. Then each attribute is connected to the database so information can be retrieved from the database and information can be updated, inserted, or deleted. Finally, the interfaces are integrated with the rest of CMESisis.

Results: The specific tools that are going to be provided were determined to be Add New Grid Region, Add New Grid Parameter, Add New Grid Level, Add New Grid Geometry, Change Grid Table, Delete Grid Data, Browse Grid Parameter, Browse As_Grid, Browse Grid Geometry, Browse Grid Model, and Browse Grid Level. The attributes that are going to be entered by the user are Region Name and Latitude and Longitude of the upper left and lower right corners of the region for the New Region interface; Parameter Name, Unit Name, Parameter Description, and Bit Count for the New Grid Parameter interface; Level Type, Level Name_1, Level Name_2, Unit Name, and Level Description for the New Grid Level interface; Geom Name, Storage Description, Beginning Epoch Time, and Geometry Description for the New Grid Geometry interface; Model and Table Name which are selected for the Change Grid Table interface; and Model, Geometry, and Grid_Id which are selected for the Delete Grid Data interface. The attributes that are going to be displayed to the user are Parameter Name which is selected and displayed, Parameter ID, Unit Name Description, Bit Count, and Unit Description for the Browse Grid Parameter interface; Model Type or Geometry Name and Dataset which are selected and displayed, Model Name, Grid ID, Geometry ID, Table Name, Record Count, User Name, Minimum Time, Maximum Time, Stamp Time, Computer Name, and Grid Data Epochal Time for the Browse As_Grid interface; Geometry Name and Model Type which are selected, Project Name, Row Count, Column Count, Latitude, Longitude, Original Row Number, Original Column Number, Geometry Parameter_1, Geometry Parameter_2, Geometry Parameter_3, Row Interval Distance, and Column Interval Distance for the Browse Grid Geometry interface; Model Name and Grid Tables which are selected, Model ID, Forecast Description, Lock Level, Created Table Type, Table Index, Table Name, Status Type, and Grid Data Epochal Time for the browse Grid Model interface; Level which is selected, Level ID, Level Name_1, Level Name_2, Unit Name, and Level Description for the Browse Grid Level interface. The add and browse tools were created and integrated into the CMESisis. Figures 1 and 2 are illustrative of these tools.

Research Advisor: Mr. Ramesh Krishnamagaru, Center for Air Sea Technology, Mississippi State University.

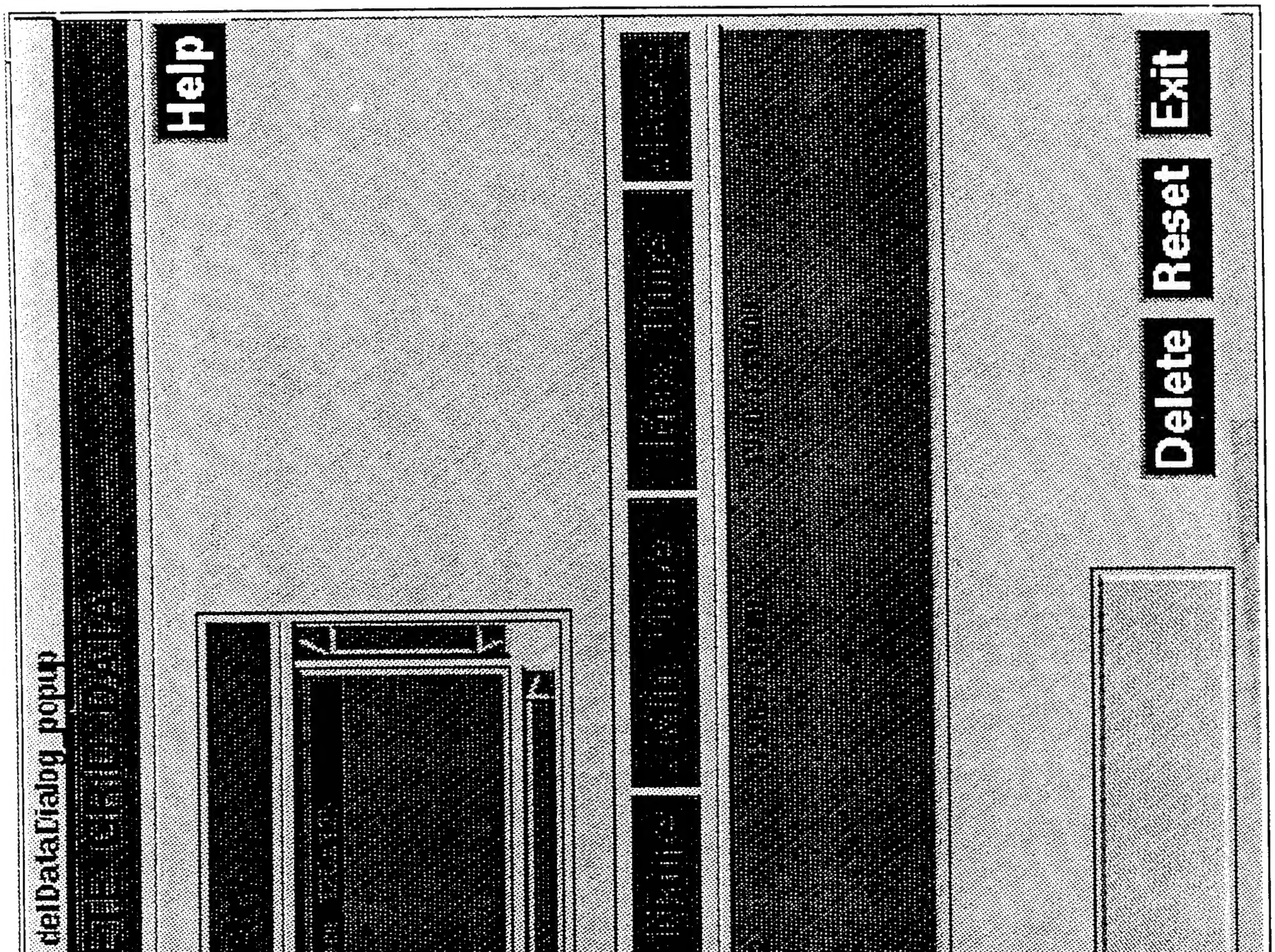


Figure 1. Delete Data

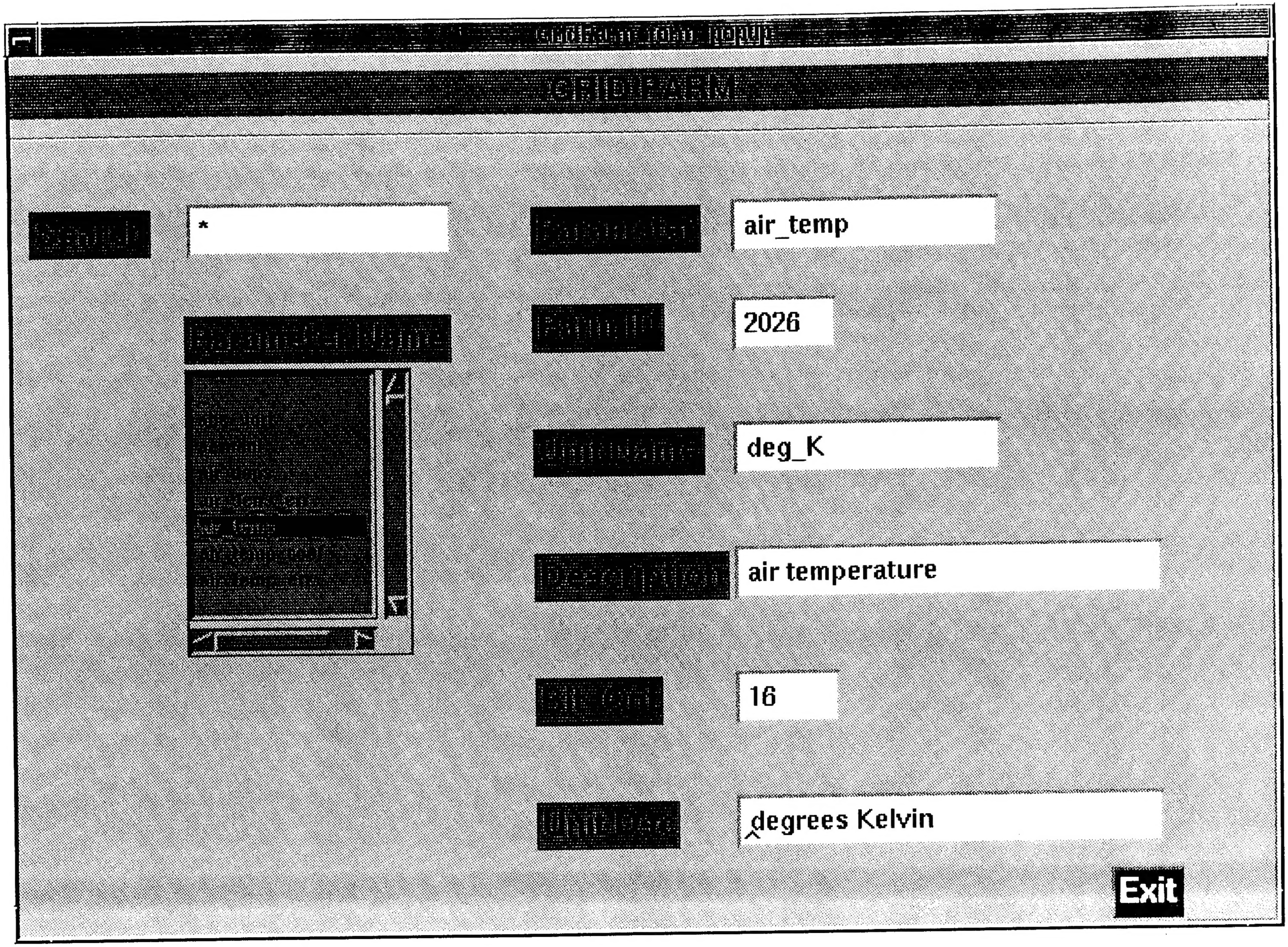


Figure 2. Browse Parameter

Billy Chambless
B.S. Program, Applied Computer Science
University of Southern Mississippi

Project #1 Title: Regional Request Handler for the Master Environmental Library (MEL)

Objective: MEL is a distributed data access system allowing users to access environmental data located on a variety of systems, with minimumal effort to the user.

The overall MEL architecture consists of one master site and multiple regional sites. The master site will maintain indexes of what types of data are available from which sites. Using these indexes, the master site will present users a single, coherent interface to the various datasets at the regional sites. Users will access the master site using a standard World Wide Web browser such as Netscape, entering their data requests on forms created by the master site. From each of these requests, the master site will generate an email message that will be sent to the appropriate regional site, which will then process the message and send the requested data back to the user. This process is almost transparant to the user, who only sees the Web form from the master site. MSU/CAST has been tasked with developing the software that will run on each regional site and handle these requests.

Approach: The first step was to develop a clear definition of the project requirements. The project team decided that a modular architecture would be the most efficient and portable approach, so the regional request handler task was developed into four main subtasks of request parsing, job scheduling, data extraction, and data delivery.

This modular approach allowed us to create small programs, each with a specific task, rather than one large server program. There are several advantages to these smaller programs; it is easier to make changes in the functionality of the system if the change only affects a small module, memory and CPU requirements are less, and development is simpler because each member of the team can develop his module(s) in an independent manner.

Once the overall design was completed, it was time to develop the actual code. The Perl programming language was ideal for this project, since it was widely available and had advanced capabilities for networking and text manipulation, both of which were vital elements for this project. Several weeks were spent in learning the Perl language, and studying internal Unix functions such as forks, signals and file locking.

My task was to develop the job scheduling module. This module coordinates the workings of all the other modules, maintaining a continual record of the progress of each request. The scheduler maintains a file containing a list of all requests, and periodically determines which stage of which request should be run next. If any step of any request fails, the scheduler generates an email message to the site's MEL administrator, allowing the administrator to take corrective action. Additionally, the scheduler logs every change in a job's status, allowing for recovery in the event of any type of system failure. After completing the scheduler, I began work on the delivery module. This module delivers the user's data to a specified FTP iite.

Results: The request parser, scheduler, extraction module and delivery module are all functional and have been demonstrated to properly work together. If any component fails, the log files allow an administrator to determine the cause of the failure and how to recover and finish filling the current requests.

Future Research Recommendations: Access control and subscription mechanisms need to be implemented, and the system as a whole needs extensive testing, especially in the area of fault tolerance. Methods for delivery other than FTP need to be added. A set of system administration tools to simplify system maintenance needs to be built, and an administrator's manual must be written.

****

Project #2 Title: Query Export/Import for ISIS Browser.

Objective: The ISIS database browser allows the user to interactively select parameters for retrieving data from a relational database management system (RDBMS). The user is presented with a menu consisting of datasets names and parameters, and is allowed to select those he wants to read from the database. The requirement was to add functionality to allow the user to save a query that might be frequently run and load that query to run again at a later time. This lets the user run repetitive queries in a batch mode rather than having to select each parameter from the menu each time it is needed.

Approach: To add these functions, I had to analyze the internal data structures used in ISIS, then write C functions to save these structures to disk and read them back. Since ISIS is based on the Motif user interface, I had to learn how to program the Motif user interface to be able to add the menu items to call the new functions. I learned Motif programming, how to read X-Window System programming and applications, and how to write small example programs. Then I added menu items to the existing ISIS menus to allow the user to call the query save and retrieve functions.

Results: The browser can now save user's queries to disk and retrieve them. The user can interactively choose which parameters he wants, then save those parameters to a file and use them later. This makes the ISIS browser much quicker and more convenient to use. The end result is a product that is simple enough for a novice user to use with little training, but flexible enough to meet the needs of a more sophisticated user.

****

Project #3 Title: Research into Public-Domain Relational Database Management Systems

Objective: Many CAST products depend upon an RDBMS such as Empress or Oracle. These proprietary systems add significantly to the cost of the final product. The objective here was to investigate those RDBMS which are available either at no cost or for a small charge. While the advantages of these systems such as low cost and the use of the very latest technology are substantial, there are concerns about their reliability. The effort was to determine if any of these systems were robust enough for production work.

Approach: After reviewing the available literature, I determined that Postgres and MiniSQL had the best specifications for CAST needs. Both programs were obtained and installed on a Sun Sparc 10 workstation, and each system was tested with a suite of standard database tasks.

MiniSQL proved more versatile and stable than Postgres. MiniSQL implements a powerful subset of the Structured Query Language (SQL), is very stable, and has an application

programming interface (API) that lets it be called from a C or Perl program. This API is required for any RDBMS used in CAST applications. A MiniSQL database was built and populated it with actual sediment property data for testing purposes. Several test programs in C were written to determine how well MiniSQL could work when called from another program.

Results: Development of the C programs was straightforward, partly due to the high quality of the API and its documentation. The programs performed well and easily extracted data. MiniSQL proved to be adequate for databases of at least moderate size.

Future Research Recommendations: MiniSQL and other free software packages should be further investigated and integrated into CAST projects. While it may not be powerful enough for some applications, MiniSQL would be more than adequate for smaller projects. While there are concerns about the lack of commercial support for these products, there is an active user group and mailing list. Also, the developers of MiniSQL are available for consultation via email at no charge.

****

Project #4 Title: Oracle Database Transfer

Objective: CAST had been running Oracle Version 7.0 on a Sun Sparc 10 workstation under SunOS. I was assigned to install Oracle 7.1 on a SparcServer 2000 running Solaris.

Approach: After reading the documentation, I prepared the needed directories on the Solaris machine and installed the Oracle software. I then performed a full export of the database from the Oracle system on SunOS, and imported that database into the new system.

Results: The new system works well under Solaris. To transfer the database from one system to another, I had to learn about the internal workings of the Oracle database management system.

Research Advisor: Mr. Ramesh Krishnamagaru, Center for Air-Sea Technology, Mississippi State University

Steve W. Payne
B.S. Program, College of Science and Technology
University of Southern Mississippi

Project #1 Title: Redesign of Navy Interactive Data Analysis System (NIDAS) Software to be Globally Relocatable

Objectives: Redesign the NIDAS database to be independent of region.

Approach: Study the current database design for NIDAS. Isolate all tables that are region dependent. Add a series of tables to the NIDAS database to reflect the geometry of the different regions being used in NIDAS, and to reflect the multiple datasets used in each region of NIDAS (Figures 1a, 1b, 1c). Create tools to browse, add, and delete the new tables introduced into NIDAS.

Results: NIDAS can now be used for any region of the globe with multiple datasets. A suite of software functions, designated NRCS (NIDAS Relocatable Configuration System), were created to manage the different regions.

Research Advisor: Mr. Ramesh Krishnamagaru, Center for Air Sea Technology, Mississippi State University.

****

Project #2 Title: Creation of an Application Program Interface (API) for the CAST Model Evaluation System (CMES) Browse Functions in Conjunction with the ISIS Database.

Objectives: Develop an API which allows an application to browse through the metadata (information about the data contained in the database). The API must be a easy to use and intuitive to make the database call transparent to the calling application.

Approach: Study the tables that contain the metadata. Decide which parameters the API will return metadata. Develop intuitive functions that will return lists of values given a metadata parameter. Create a program to test the function. Document the API so that others may use it with ease.

Results: An API was created for CMESisis browse functions and later incorporated into CMES isis by Mr. Clifton Abbott.

Research Advisor: Mr. Ramesh Krishnamagaru, Center for Air sea Technology, Mississippi State Unversity.

****

Project #3 Title: Extracting, Manipulating, and Visualizing Topex/Poseidon Satellite Altimetry Data.

Objectives: Remove seasonal influences of sea surface height from TOPEX/Poseidon altimetry data, perform Fourier transformation on the resulting data, and visualize the results.

Approach: First decompose the TOPEX/Poseidon altimetry data into component signals using the Fourier transform. Plot the resulting signals in the spacial domain. Generate time series for several points within the region of interest (Figures 2 and 3). Next, remove semi-annual forces

and linear trends from the raw data to expose the signal resulting from wind forcing. Generate a comparison set of maps and time-series to reflect the remaining signal (Figures 4 and 5).

Results: A series of plots were created to show the cyclic effects of wind forcing in the South Pacific.

Research Advisor: Mr. Alberto Mestas-Nunez, Oregon State University.

****

Project #4 Title: Adding Global Boundary Conditions to the Relocatable Model Environment (RME) Graphical User Interface (GUI).

Objectives: Develop a generic way to add boundary conditions to models while optimizing speed and increasing efficiency.

Approach: A generic solution to the problem has to be created. To do this, convert the boundary condition files to the netCDF format (Figure 6). This format allows architecture independent subsetting of datasets while compressing the data into a binary format. This will greatly improve access time and efficiency, while making possible the use of a higher resolution global boundary condition file. By using a generic solution, adding other sources for boundary conditions becomes trivial.

Results: A global boundary condition file provided by the University of Colorado was added to the RME GUI. The capability for other boundary files to be imported was also built.

Research Advisor: Mr. Valentine Anantharaj, Center for Air Sea Technology, Mississippi State University.

****

Project #5 Title: Creation of Various Graphic Products

Objectives: To be able to efficiently create graphic products for a variety of purposes.

Approach: Obtain a public domain copy of the Generic Mapping Tools (GMT) from the University of Hawaii. Become familiar with the syntax and paradigm of the GMT package. Learn about subsetting data, color map editing, contouring, vector plots, 3D surfaces, color images, interpolation of data and various map projections.

Results: CAST is now able to quickly and easily generate a variety of informative and intuitive graphic products as shown in Figure 7.

Research Advisor: Mr. Valentine Anantharaj, Center for Air Sea Technology, Mississippi State University.

NIDAS Phase II

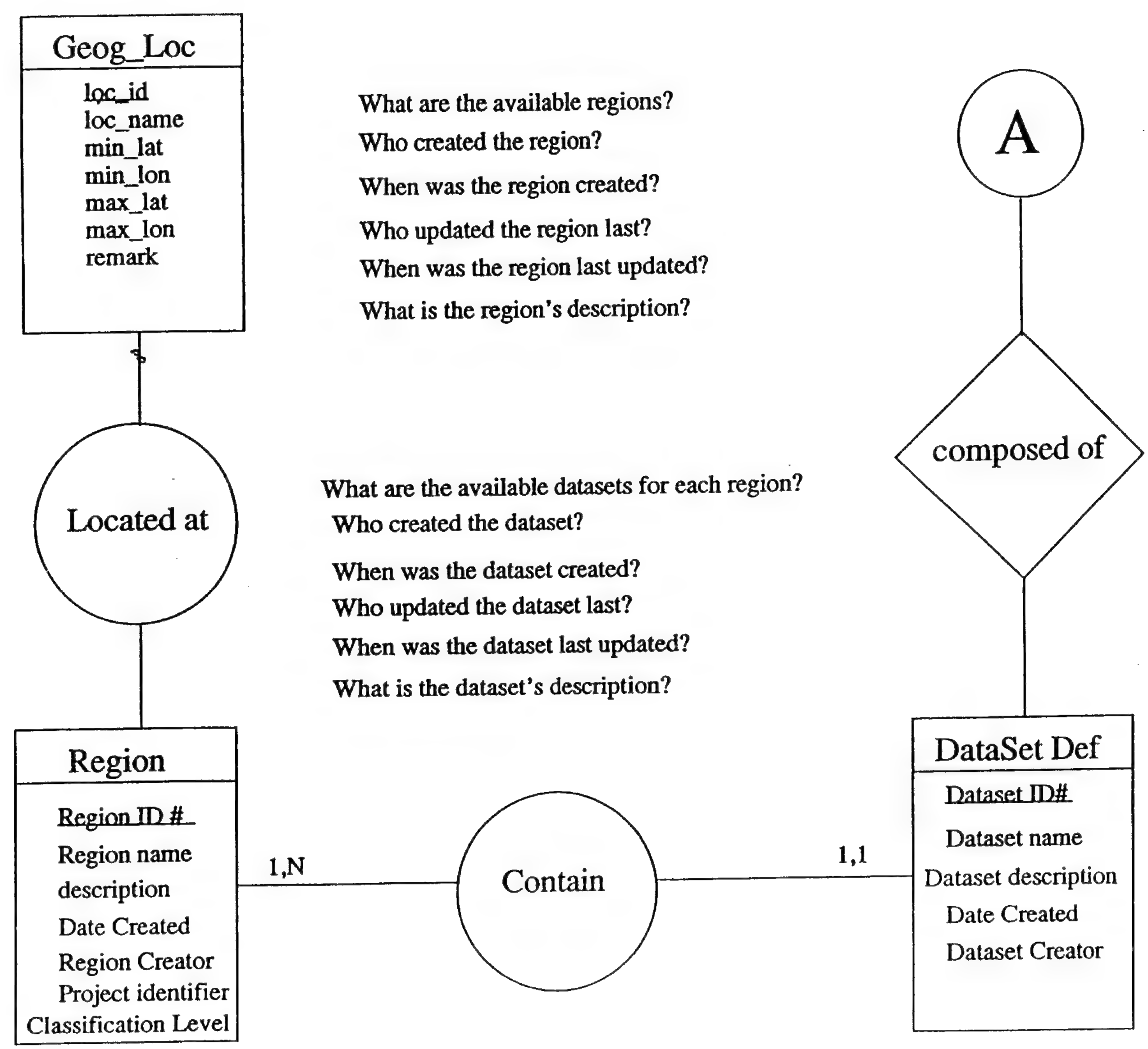


Figure 1a.

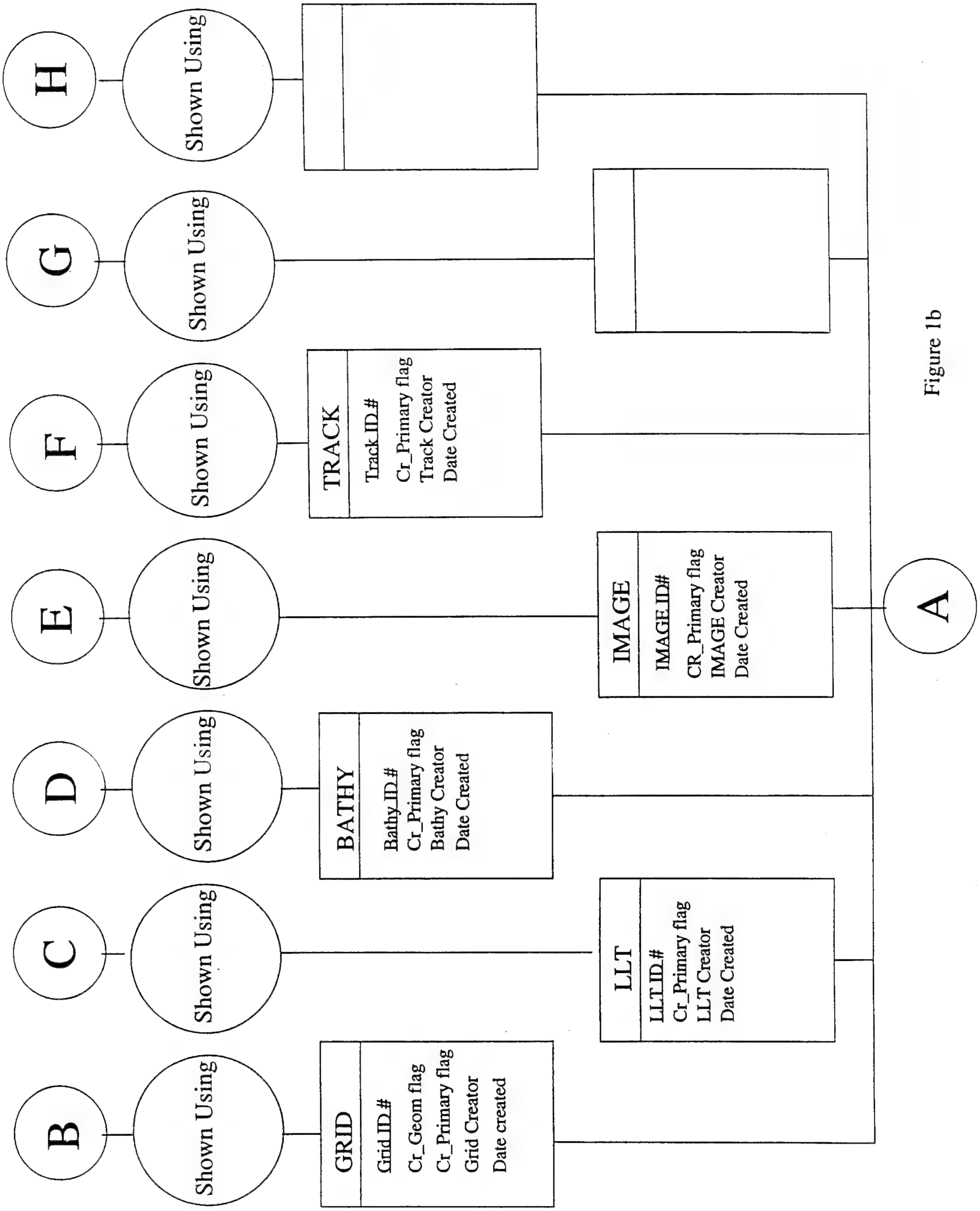
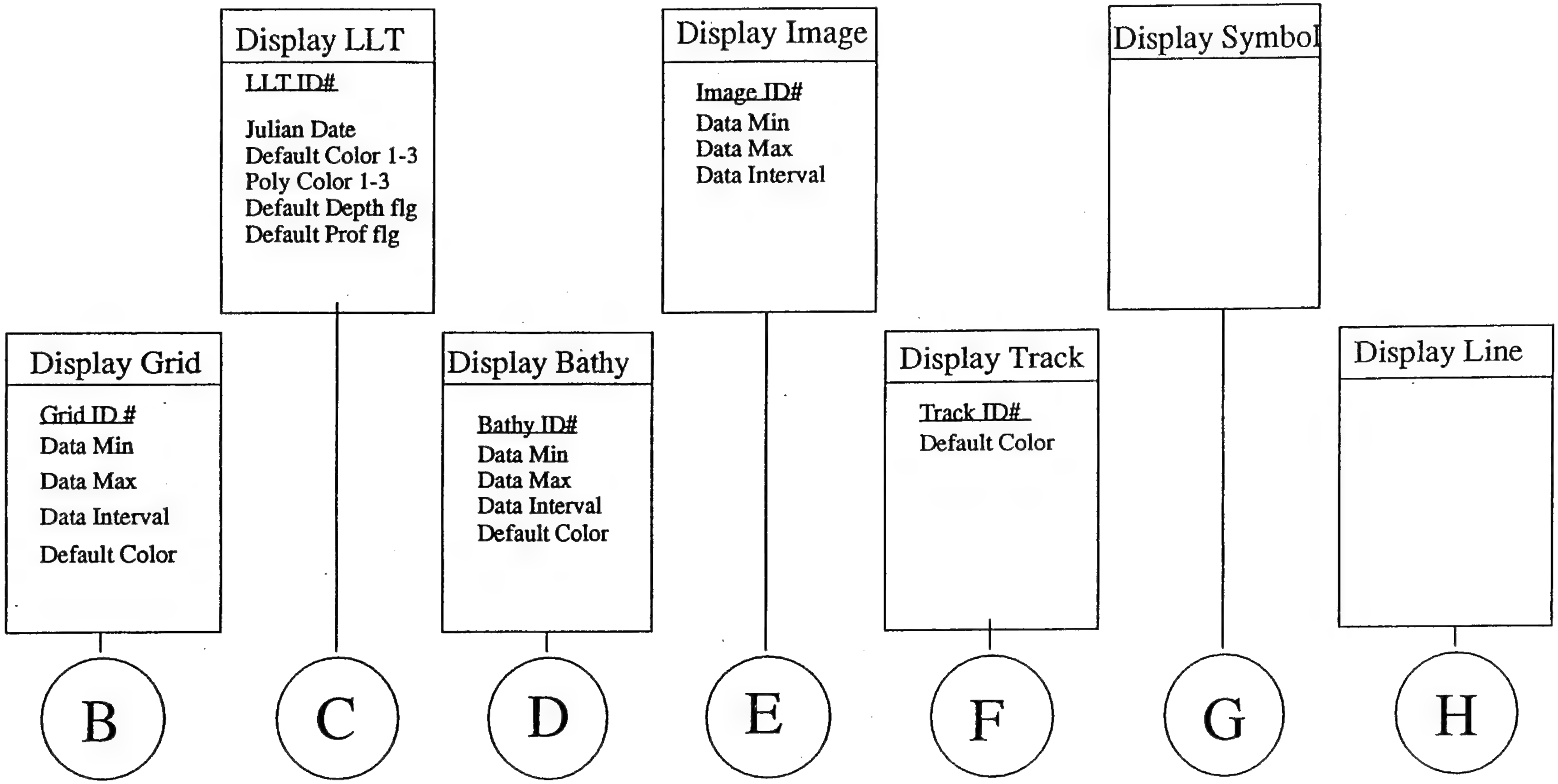

B
Shown Using
GRID
Grid ID #
Cr_Geom flag
Cr_Primary flag
Grid Creator
Date created
C
Shown Using
LLT
LLT ID #
Cr_Primary flag
LLT Creator
Date Created
D
Shown Using
BATHY
Bathy ID #
Cr_Primary flag
Bathy Creator
Date Created
E
Shown Using
IMAGE
IMAGE ID#
CR_Primary flag
IMAGE Creator
Date Created
F
Shown Using
TRACK
Track ID #
Cr_Primary flag
Track Creator
Date Created
G
Shown Using
H
Shown Using
A

Figure 1b



Display Grid
Grid ID #
Data Min
Data Max
Data Interval
Default Color
B
Display LLT
LLT ID#
Julian Date
Default Color 1-3
Poly Color 1-3
Default Depth flg
Default Prof flg
C
Display Bathy
Bathy ID#
Data Min
Data Max
Data Interval
Default Color
D
Display Image
Image ID#
Data Min
Data Max
Data Interval
E
Display Track
Track ID#
Default Color
F
Display Symbol
G
Display Line
H

Figure 1c

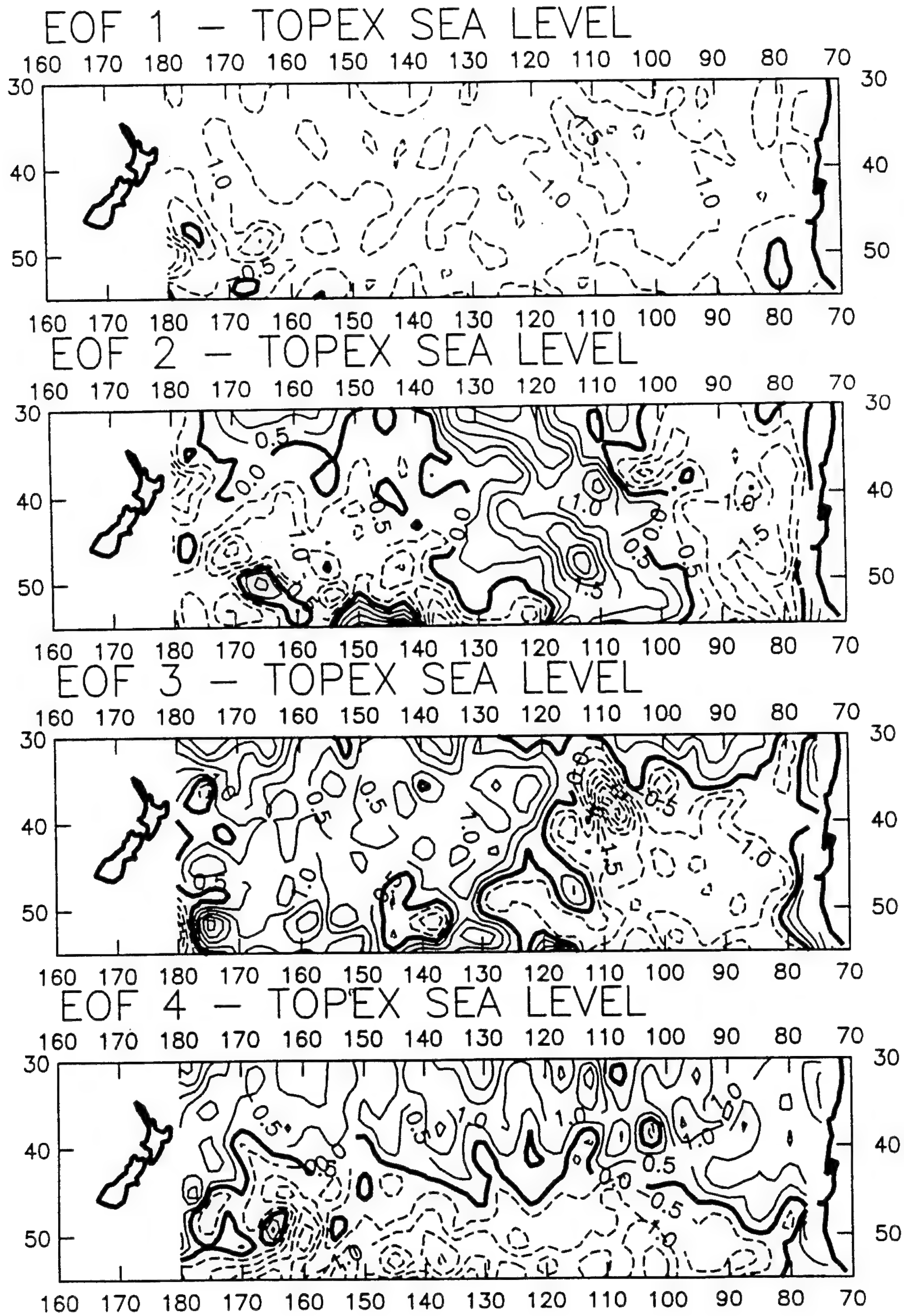

EOF 1 – TOPEX SEA LEVEL
EOF 2 – TOPEX SEA LEVEL
EOF 3 – TOPEX SEA LEVEL
EOF 4 – TOPEX SEA LEVEL
160 170 180 170 160 150 140 130 120 110 100 90 80 70
30
40
50

Figure 2.

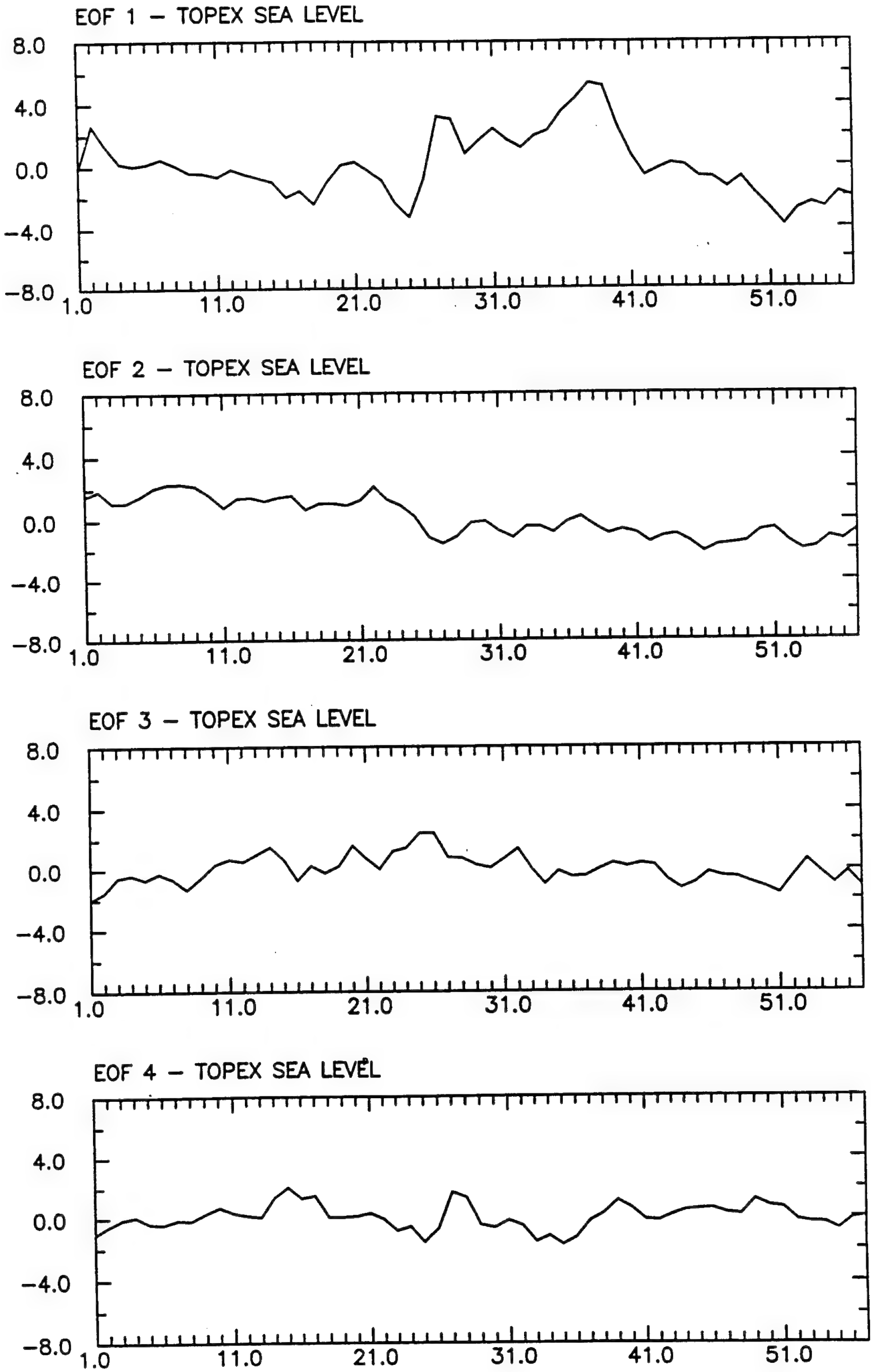

EOF 1 – TOPEX SEA LEVEL
8.0
4.0
0.0
–4.0
–8.0
1.0
11.0
21.0
31.0
41.0
51.0
EOF 2 – TOPEX SEA LEVEL
8.0
4.0
0.0
–4.0
–8.0
1.0
11.0
21.0
31.0
41.0
51.0
EOF 3 – TOPEX SEA LEVEL
8.0
4.0
0.0
–4.0
–8.0
1.0
11.0
21.0
31.0
41.0
51.0
EOF 4 – TOPEX SEA LEVEL
8.0
4.0
0.0
–4.0
–8.0
1.0
11.0
21.0
31.0
41.0
51.0

Figure 3.

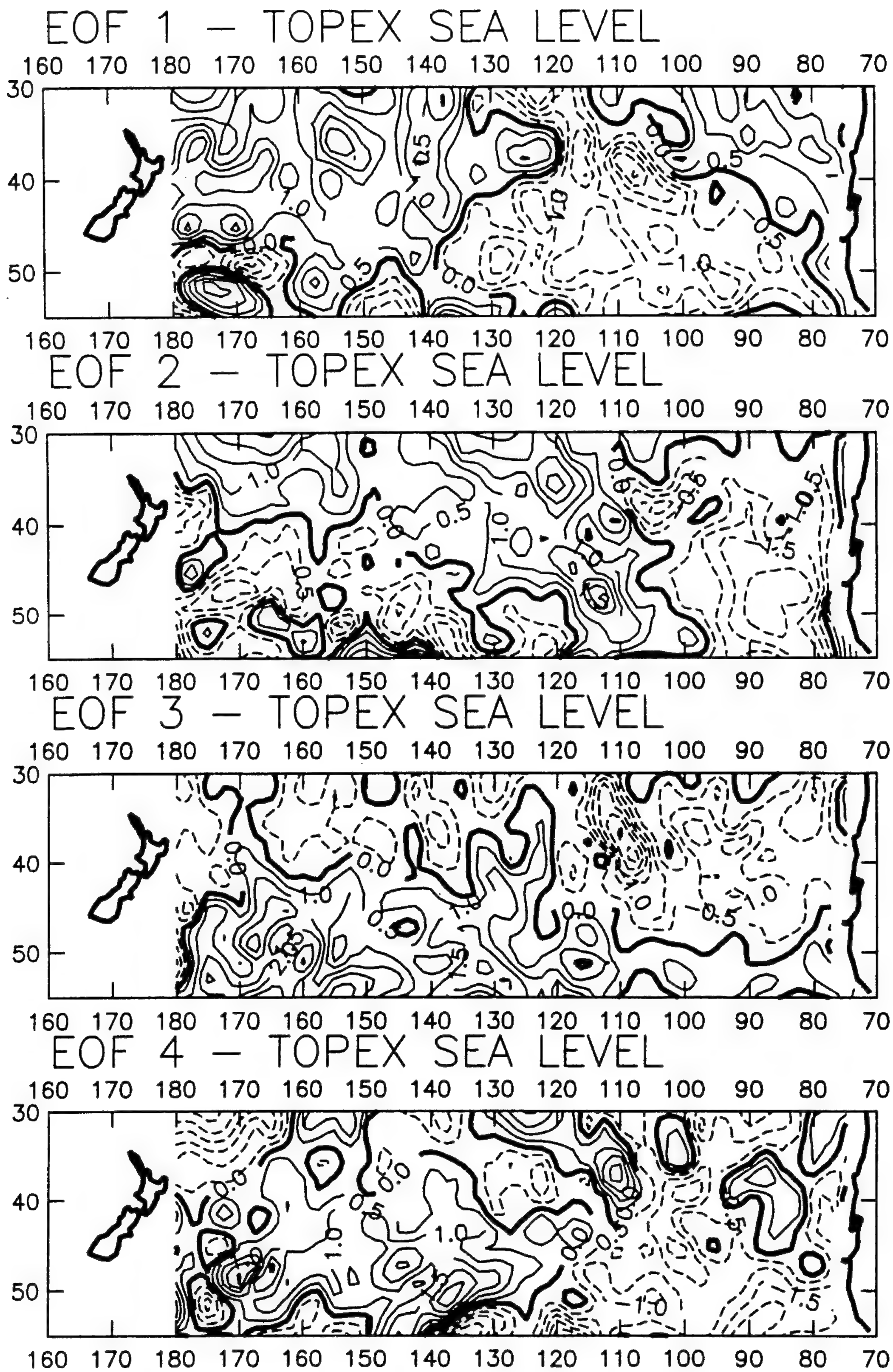

EOF 1 – TOPEX SEA LEVEL
EOF 2 – TOPEX SEA LEVEL
EOF 3 – TOPEX SEA LEVEL
EOF 4 – TOPEX SEA LEVEL
160 170 180 170 160 150 140 130 120 110 100 90 80 70
30
40
50

Figure 4.

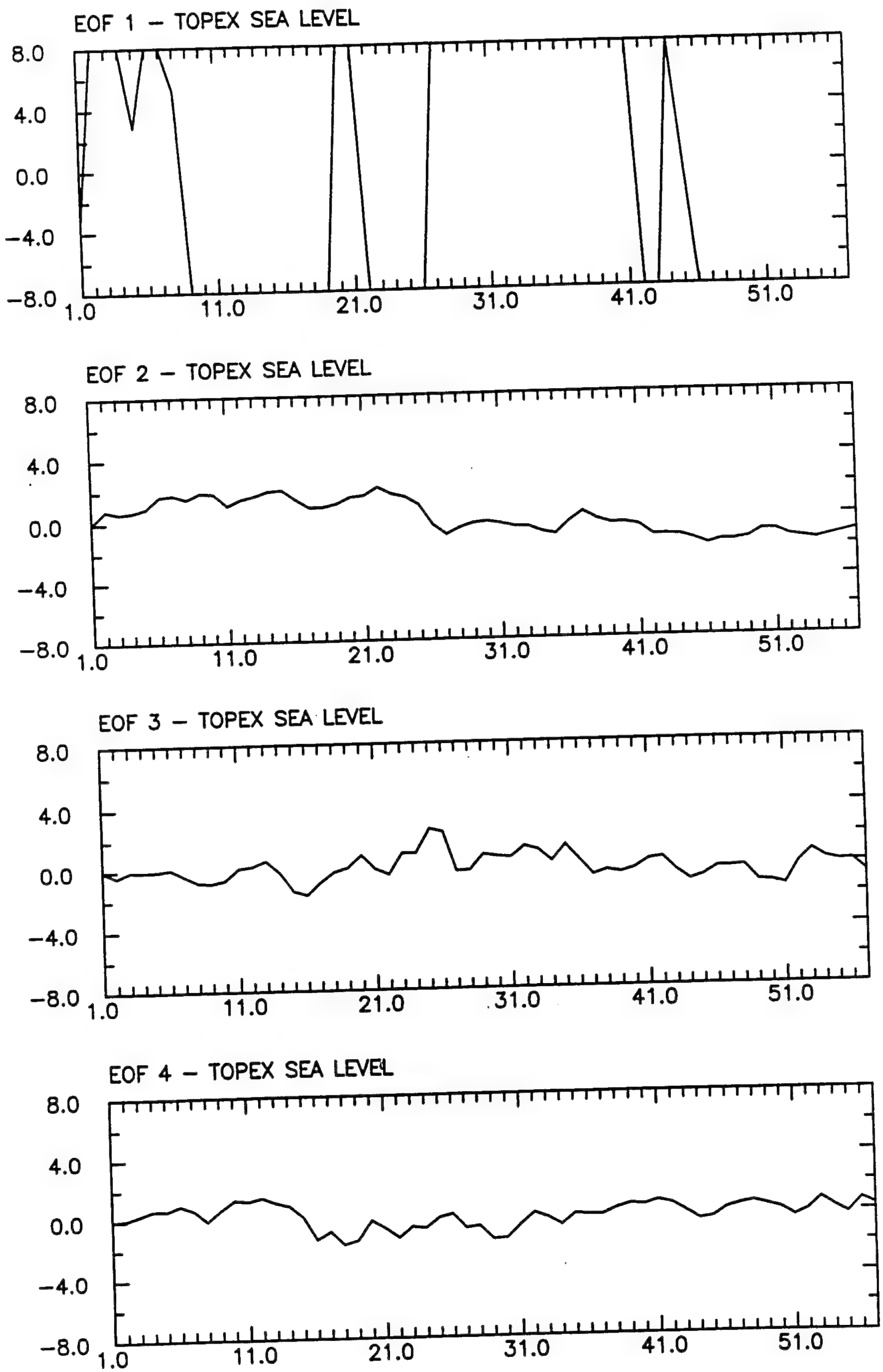

EOF 1 – TOPEX SEA LEVEL
8.0
4.0
0.0
−4.0
−8.0
1.0
11.0
21.0
31.0
41.0
51.0
EOF 2 – TOPEX SEA LEVEL
8.0
4.0
0.0
−4.0
−8.0
1.0
11.0
21.0
31.0
41.0
51.0
EOF 3 – TOPEX SEA LEVEL
8.0
4.0
0.0
−4.0
−8.0
1.0
11.0
21.0
31.0
41.0
51.0
EOF 4 – TOPEX SEA LEVEL
8.0
4.0
0.0
−4.0
−8.0
1.0
11.0
21.0
31.0
41.0
51.0

Figure 5.

netCDF File Format

dimensions:

```
        lat                          ; latitude
        lon                          ; longitude
        time                         ; time
```

variables:

```
        float latitude(lat, lon)           ; latitude array
        float longitude(lat, lon)          ; longitude array
        char time(time)                    ; time array
        float k1_amp(time, lat, lon)       ; tidal component amplitude array
        float k1_phase(time, lat, lon)     ; tidal component phase array
        .
        .
        .
```

global attributes:

```
        :missing_value          ; value to set all missing elements in the arrays
        :title                  ; name of the region
        :grid_type              ; what type of geometry(regular, irregular, etc)
        :y_resolution           ; resolution of grid in y direction
        :x_resolution           ; resolution of grid in x direction
        :orig_lat               ; latitude of origin
        :orig_lon               ; longitude of origin
```

figure 6.

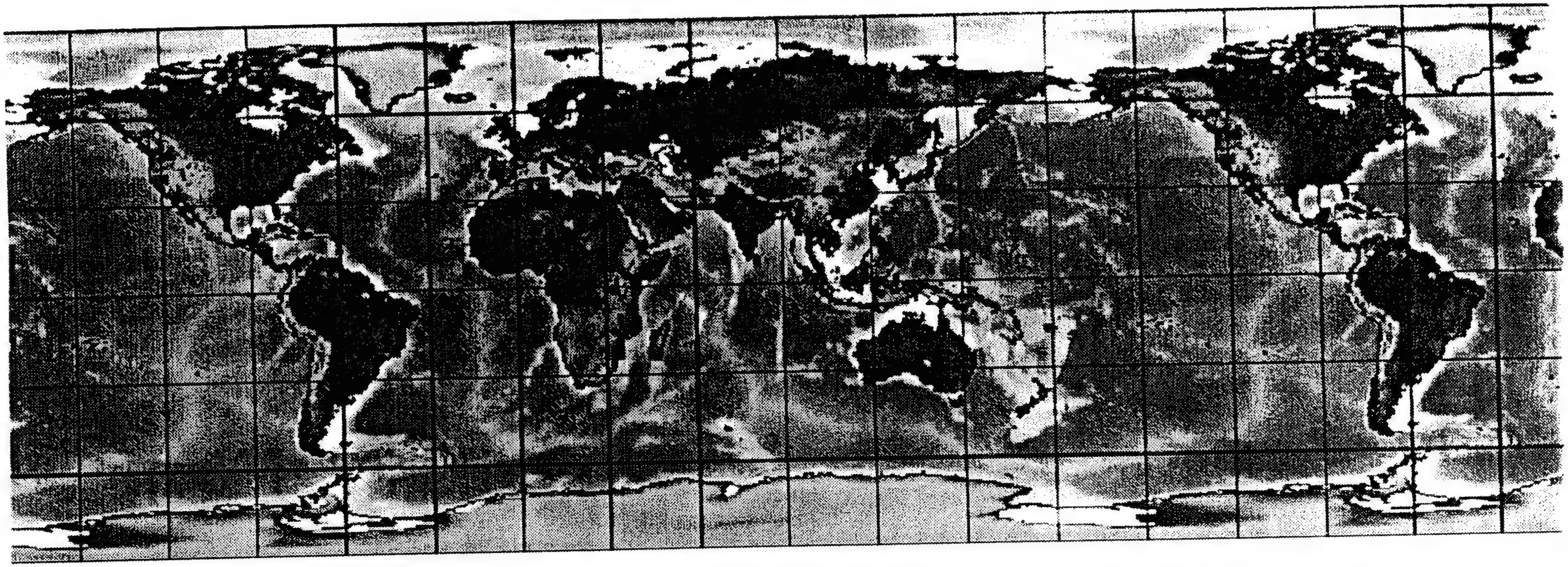


Figure 7.

Shannon L. Ellis and E. Maria Lindberg
B.A. Program, William Carey College

Project Title: Graphic Design in the Atmospheric/Oceanic Research Environment

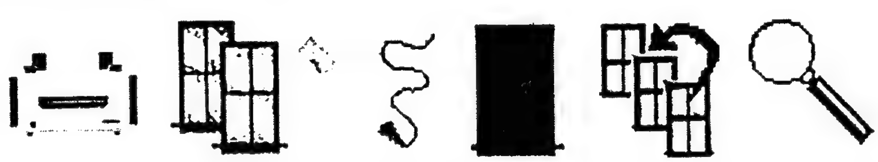
Objectives: In the ever changing world of science our primary objective was to increase clarity in communication by merging science, innovation, and graphic design. Other objectives were to give CAST not only a new image, but an identity. An identity intended to give recognition and credibility to CAST, not only in the world of environmental science, but also in the world of software engineering and electronic communication.

Approach: Our approach in reaching these objectives was to integrate our ideas with ideas of others external to CAST. We developed a logo that clearly identifies CAST. The way that this was accomplished was by preparing a broad spectrum of ideas related conceptually to given elements of the air and sea, and by consulting with CAST oceanographers, meteorologists, software engineers, as well as outside graphic designers. Through this process, we developed the following logo:

The progression to this logo may be seen in our preliminary sketches which follow:

Through each step of development our design became clearer and stronger conceptually. Consideration was also given to technical factors, such as how it read visually in black and white, and how well it copied and faxed. Once the logo was completed letterhead and business cards were designed.

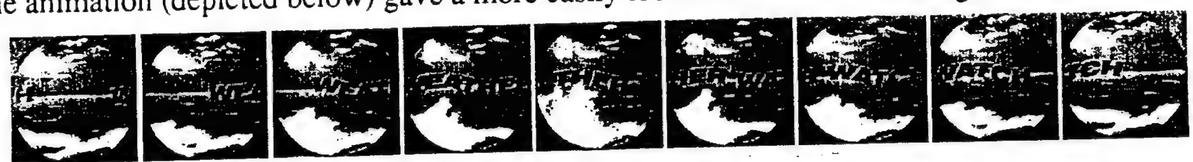
Other projects requiring the merging of ideas were in designing new icons and interfaces for computer software that was developed within CAST. Some examples follow:



Before the design process began, we researched on the functions of the proposed icons and interface elements. Working with software engineers and scientists we not only gained an understanding of their jobs, but were able to do ours better. Taking this knowledge into consideration, we interpreted these functions into images that will be clearly understood by the user.

One of the many different ideas we had when working on the CAST logo turned out to be useful as an icon for Weather Watch software. The original image (shown below) was slightly altered into nine separate frames which was animated on a Silicon Graphics workstation.

The animation (depicted below) gave a more easily identifiable and interesting introduction.



With assistance from Mr. Johnathon Howard of WLOX- TV13, we were able to produce a ten second movie animation of one logo, using an AVID 100 and MediaComposer 5.2.1. We combined the logo with weather footage, sound effects, music, and voice over. This clip will eventually become part of the CAST homepage on the Internet.

The interface for NIDAS software was also revamped, with the primary change made in the use of color. Taking into consideration that this software was used by scientists for long periods of time, the color scheme needed to be changed to avoid eye strain. The previous colors used (blue-green and red) are classified as complimentary colors. Medical science has shown that the eye cannot focus on two complimentary colors simultaneously, without focusing and refocusing from one color to the complimentary color. To reduce eye strain the color scheme was changed to three monochromatic blues. Text sizes were also changed to add functional clarity.

An interface for NIDAS top index was also developed for the World Wide Web. This document incorporated our new logo, as well as a color coding system that allows the user to always be aware of his/her location within the document. Before we were able to reach our goals we did research to find the software that would best suit our needs. We were advised by Ms. Debbie Baer, an instructor at William Carey College and Art Director for WLOX-TV 13. We also consulted with Mr. Allen Jenkins, graphic designer and owner of Powerlines Advertising and Design. We also traveled to Mississippi State University's Engineering Research Center, where we met and consulted with computer artists Ms. Holly Beeland and Mr. Michael Mott. The overwhelming choice of software used on the Power Macintosh was Adobe Photoshop 3.0. We decided to use Adobe Illustrator based on the knowledge that we had acquired. We also received technical advice on subjects such as, file formats, audio- video formats, resolutions, HTML and internet documents, transferring files over the web, poster production, video production and quicktime movies for Netscape.

Results: A well thought out conceptual logo. Not just an image, but more of a symbol for excellence, innovation, and hard work. By adding clarity in interface design, CAST software is more efficient to use. By using better color schemes the software is easier on the eyes enabling researchers to work for longer periods of time without fatigue.

Future Research: To construct a new homepage for CAST on the Internet. This new homepage will incorporate more indepth information and computer graphics in a clear, coherent, and aesthetic manner. Another objective is to add animation to the homepage, as well as conduct marketing reseach.

Edward A Clark
B.S. Program, College of Science and Technology
University of Southern Mississippi

Project #1 Title: Design and Construction of a Regional Site Data Extractor for the Master Enviromental Library (MEL) Project.

Objective: To construct a regional data extractor for use on the NEONS database.

Approach: Study input request and required output. Develop a Perl program that accomplishes the five functions of (1) parsing a request-text file, (2) generating additional information needed to process request, (3) generate an input template, (4) calling a C program to accomplish the data extraction, and (5) capturing and logging status information and error messages.

Result: Allows CAST to demonstrate MEL Regional Site Data extraction software.

Research Advisor: Mr. Ramesh Krishnamagaru, Mississippi State University.

****

Project #2 Title: Learning Programming Languages and Unix Operating System/Utilities.

Objective: To become competent in the use of the Practical Extraction and Report Language (Perl), Empress, NEONS, Unix operating system (SunOS and Solaris) and various Unix utilities.

Approach: Learn Perl through the use of manuals and tutorials on the World Wide Web (WWW). Develop skills by writing programs to compare different program versions. Become familiar with the use of EMPRESS and NEONS. Develop skills by completing the EMPRESS SQL tutorial. Develop Unix skills using manuals and "man" pages.

Results: Increased CAST productivity by applying new skills to current projects.

Research Advisor: Mr. Ramesh Krishnamagaru, Mississippi State University.

****

Project # 3 Title: Installation and Modification of NEONS Version 4.1 for Solaris 2.4.

Objective: Install a modified version of NEONS 4.1 on a platform running Solaris 2.4 to replace NEONS 3.4 running in a SunOS environment.

Approach: Became familiar with the basic structure and operations of NEONS, NEONS' database, NEONS' browse functions, and a data browser program. Use Unix utilities to compare NEONS 4.1 and NEONS 3.4 and study the differences. Modify NEONS 4.1 to incorporate locally developed browse functions. Install NEONS 4.1 on Solaris platform by editing its make file and recompiling. Use EMPRESS 6.2 export utility to copy the NEONS 3.4 database and EMPRESS 6.6 import utility to populate the NEONS 4.1 database. Test and evaluate CAST version of NEONS 4.1 with data browser program.

Results: NEONS 4.1 with CAST modifications and its database are installed on a platform running Solaris 2.4 environment.

Research Advisor: Ms. Cheryl Cesario, Mississippi State University

Ognen Zografski
B.S. Program, Computer Science
Mississippi State University

Project #1 Title: Learning HTML and its Application in Authoring Online Help Systems.

Objective: The objective was to obtain experience in writing HyperText Markup Language documents and to apply it in preparing online help documentation.

Approach: In collaboration with Mr. Michael Baer, I used common HTML authoring and other tools to help in the implementation of the CMES online hypertext help system.

Results: Assisted in the implementation of the CMES help system.

Recommendations for Future Research: Learning the Java language, which is suitable for writing "applets" programs delivered on the Internet and executed on different machines. Java is considered to be the successor of HTTP/HTML.

****

Project #2 Title: HTML Documentation for NIDAS

Objective: The HTML documentation for NIDAS was to be designed as an online help system. The goal was to enable the users to find information quickly and efficiently. The system had to be easily navigable and intuitive for optimum ease of use.

Approach: Drawing from other HTML documentation projects at CAST, specifically the CMES help system, I attempted to give the NIDAS documentation a look and feel of the "real" application, as well as provide clear, step-by-step instructions on accomplishing common tasks. Finally, sufficient information about the underlying architecture of the application was to be provided.

Results: The NIDAS help system was designed with sections on how to do the most common tasks, with a textual description of the applications and the use of clickable images replicating the NIDAS GUI. This design provided optimal ease of navigation and accuracy in mimicking the functionality of NIDAS, thus helping smooth the learning curve for new users.

****

Project #3 Title: Learning Motif Programming

Objective: Familiarization with the Motif library of widgets and the architecture of the Motif Application Programming Interface.

Approach: To write several widgets which use the most common types of Motif data structures/ event handling including menu bars, pulldown and cascading menus, scroll bars, text panes and entry areas, button, sliders, checkboxes, and listboxes.

Results: Gained proficiency in writing Motif widgets and simple applications.

Recommendations for Future Research: To learn a GUI design automation tool such as Xdesigner. Having learned the basics of Motif, the next step is to learn how to use some of the GUI builder tools.

Research Advisor: Mr. Ramesh Krishnamagaru, Mississippi State University.

Zhifan Zhu
Ph.D Program, Engineering Research Center
Mississippi State University

Project Title: Extracting and Visualizing Ocean Eddies in Time-Varying Flow Fields

Objective: Recent progress in global scale ocean circulation modeling has made visualizing ocean model data an important application area of flow visualization. Due to the complexity of ocean flow fields, however, it is difficult to apply traditional techniques of flow visualization. These difficulties come not only in finding a meaningful visual representation of the flow, which is still a challenge in flow visualization, but also in handling the huge amount of data, often gigabytes, from the high-resolution models.

The prevailing paradigms for visualizing numerical flow fields include the hedgehog and flow lines [CMB94, vWHdLP94]. The basic hedgehog technique involves plotting arrows at grid points to show the flow magnitude and direction. Although stable, its application is limited by two primary drawbacks: it is essentially a 2D technique and it lacks continuity in representing the flow fields. Flow lines imply all particle-based techniques, including streamlines, stream surfaces, particle traces, etc. The streamline method is well suited for steady or slow-motion flow fields. It is able to show the detailed local flow properties, but not the whole picture without an exhaustive generation of streamlines. Another category of flow visualization technique is based on vector field topology [HH91]. In this method the local flow structure is first identified in a region and icons are used to depict the fluid dynamics in that region [vWHdLP94]. The technique is able to visualize the detailed flow mechanism in a small region of 3D space. The structure of the icons is important in order to provide a more understandable visual representation of the local flow properties.

In visualizing large time-dependent ocean flow fields, two related issues need to be considered in choosing the appropriate technique and the most meaningful visual construction method. First is the application scope be it global or regional. A global view leads to a quick understanding of the overall circulation system, while a detailed investigation focused on a particular region of interest provides a higher-resolution comprehension. These two applications require different visualization techniques for optimizing efficiency and accuracy.

The other issue is the processing level which is frequently application dependent. A low processing level means visualizing the raw data without discerning which data are significant and which are trivial. With this method, visualization requires only properly mapping the flow fields onto images. Animation is often needed to disclose the temporal properties of the flow fields. On the other hand, if the high-level ocean features are the application of interest, as is often the case, visualization directly focused on these features makes more sense.

In the context of ocean circulation, eddies are a dominant physical phenomenon [Rob83]. Observing the migration and interaction of eddies over time and space is of great importance for oceanographers to understand ocean circulations. This paper presents a technique for extracting and visualizing ocean eddies. Four years of data from a longer term simulation of the Pacific Ocean [HWSM92] are used as test data to show the capabilities of the technique.

Approach: A typical eddy in the ocean flow fields has a closed or semi-closed circulation pattern. Since the vertical motion is negligible (no vertical velocity component in the data), eddy recognition in the 3D space can be done by detecting its 2D elements at each layer. In the unsteady (time-varying) flow fields, an eddy consists of a sequence of instances, sampled at a consecutive time instance in the data. Thus, an eddy can be decomposed into time-independent 3D instances which are then further decomposed into 2D elements. Identifying eddies is the

reverse process of the decomposition. For example, find 2D elements and coalesce them into 3D instances. Once extracted, eddies can be visualized by mapping into visual images.

The algorithm starts by computing the centers of 2D elements at all layers. This is done by using the critical point concept to find the spiral centers [SJ92]. With each located 2D element center are associated three basic flow properties, viz., curl, deformation, and divergence. Then a 3D correlation function is used to recognize eddy instances from the detected 2D element centers. The correlation depends on the horizontal locations and the three flow properties. Application criteria, e.g., minimum size and curl, may be employed to eliminate smaller ones.

To approximate an eddy's shape and capture its instantaneous characteristics, the simplified geometric deformable model, or SGDM, has been developed. The use of a geometric deformable model to construct 3D object in scalar fields was presented by [MBL+91]. The concept is extended here to flow fields with different constraints. The SGDM is a simple piece-wise closed 2D deformable model, created about each 2D element center. See Figure 1. An error quantity is calculated over the piece-wise vector differences between the line segments of the SGDM and the local velocities. An iteration process is used to expand the SGDM to obtain the maximum size while maintaining its closure and keeping the error quantity below a prescribed constraint. In the implementation, this deformation process may begin by placing a small closed model (e.g., a circle or ellipse) around the center and then expanding the model outwards until the error quantity surpasses the threshold. The physical structure of an eddy instance is approximated by the set of SGDMs at each layer. See Figure 2. Vertically, an eddy instance spans a set of successive layers where SGDMs have been successfully formed.

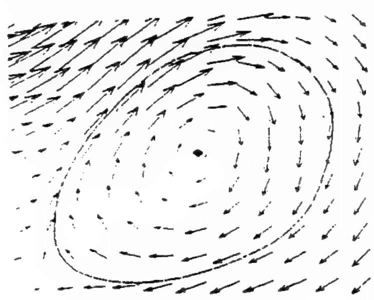


Figure 1. An example of a SGDM. The dot in the middle is the center of the eddy. The background arrows represent the local velocities.

Figure 2. An example of the 3D construction of an eddy from SGDMs. The radiation pattern is randomly generated to animate the eddy rotation. The white lines are SGDMs at various layers.

The SGDM also provides a good framework from which much of an eddy's dynamic information can be estimated. In particular, an eddy's horizontal translational speed and rotation frequency are very useful in tracking and visualization. The instantaneous translational speed is estimated as the net speed over the grids enclosed by the SGDMs. The rotation frequency is computed from the tangent speeds on the SGDM with respect to the center (see Figure 1).

Since an eddy is considered a temporal phenomenon, the complete description must include all its instances along the time axis and the associated properties. Tracking is used to determine which eddy instances belong to the same eddy. It is a predicting and matching process. Prediction is used to predict the eddy's geo-location from its previous location and translational velocity. The correlation probabilities of eddy instances are calculated between successive time instances. The correlation probability reflects the likelihood of a particular property of an eddy from instance to instance. The ultimate probability, which measures the closeness of two eddy instances, is the weighted sum of the correlation probabilities:

$$P(i,j) = \sum_{K=1}^{N} w_k P_k(i,j)$$

For nT and nT+1 eddy instances detected for time instance T and T+1, respectively, a nT by nT+1 matrix of matching probabilities is generated:

$$\begin{pmatrix} P(1,1) & P(2,1) & \cdots & P(n_T,1) \\ P(1,2) & \ddots & & \vdots \\ \vdots & & P(i,j) & \vdots \\ \vdots & & \ddots & \vdots \\ P(1,n_{T+1}) & \cdots & \cdots & P(n_T,n_{T+1}) \end{pmatrix}$$

Tracking is simply finding the real matches from the probability matrix. A minimum matching probability constraint is imposed to prevent false matches from occurring.

Results: Two sub-regions were selected for use of the NRL Pacific Ocean Circulation Model [HWSM92] (Figure 3). Region A covers the area along the western coast of North America, from 145°W to 110°W and from 15°N to 62°N. Region B extends from 135°E to 170°E and from 35°N to 62°N, containing the Kuroshio Sea area near Japan. The total data size (four years) is about 2.6 gigabytes for A and 1.5 gigabytes for B.

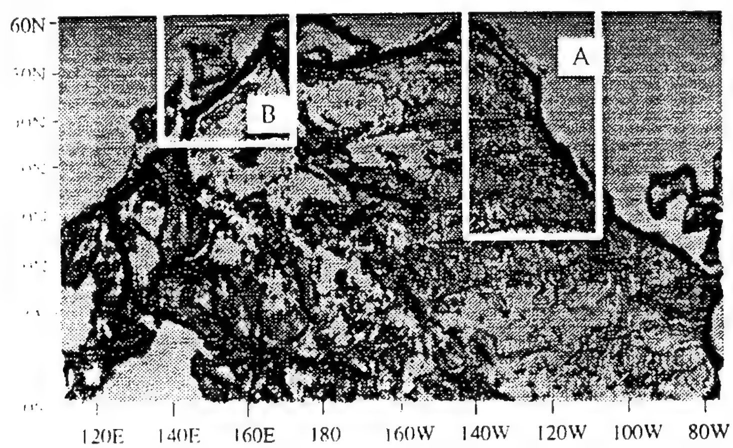
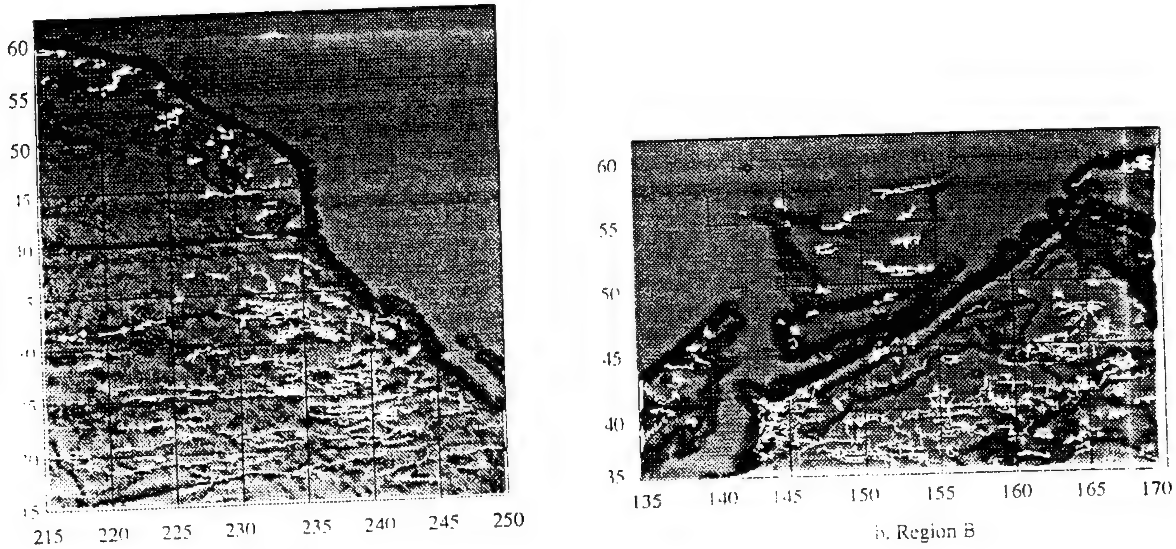


Figure 3. Two sub-regions in the Pacific Model.

The algorithm was implemented and the results were saved in eddy description files. Visualization involved simply rendering the results and mapping each eddy's characteristics into proper visual forms. In Figure 4 are the visualized trajectories of the eddies. They are traced by the eddy centers. Animation of these trajectories is able to illustrate the eddy migration. In Figure 4a, the eddies which emerged below 30°N latitude travel consistently westward in long paths, since the circulation in that area is dominated by the North Equatorial Current. On the other hand, the eddies created near the coast above 40°N tend to meander without being pinched off the coast. No long-term eddy migration pattern is visible in Region B, which includes the sea of Okhotsk, part of the Sea of Japan, and part of the North Pacific Basin around Kuroshio.

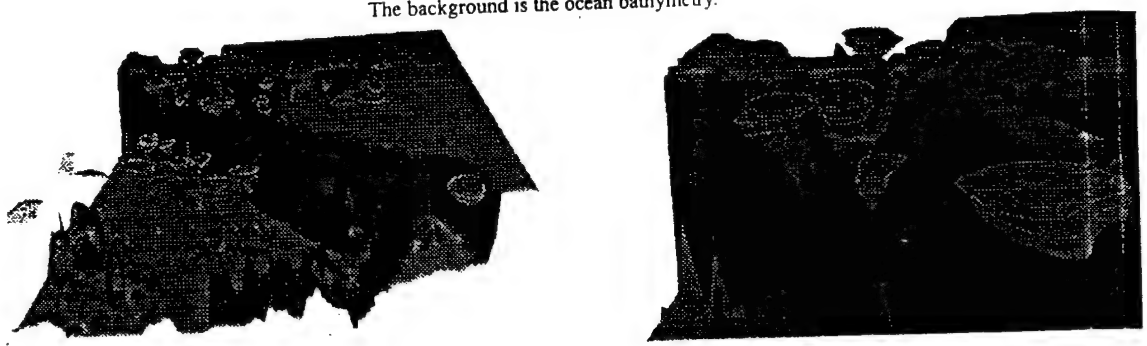
In Figure 5 are snapshots of the animated visualization from Region B looking westward. Figure 5a presents a global picture of the eddies at a time instance and Figure 5b is a 'zoomed-in' image focused on the southwestern corner of the region. The eddy shapes are approximated by SGDMs in each layer. They appear as amorphous objects in the flow fields. The colors on the eddies indicate the instantaneous rotation speed, which is proportional to the energy. In order to animate the eddy rotations, the brightness of the color is modulated by random numbers, resulting in a random pattern radiating from the eddy center (see Figure 2).



a. Region A

b. Region B

Figure 4. Trajectories of eddies (white).
The background is the ocean bathymetry.


a. Region B

b. A part of Region B

Figure 5. Snapshots of animated eddy visualization in Region B. The view is from east to west. The background is the ocean bathymetry.

Conclusion and Further Work: Visualization of global scale ocean models is an important application of flow visualization. It is also a challenge due not only to the inadequacies of traditional approaches but also to the difficulty in handling the massive data volumes. The technique discussed in this paper presents a methodology for directly extracting and visualizing ocean eddies, the most prominent phenomenon in ocean physics. It is a high-level feature-oriented flow visualization approach which is particularly useful in providing insights into the dynamic flow mechanisms of eddies. Focusing on extracted features makes the visualization flexible enough to handle various applications and helps to alleviate the visualization dilemma when both a global picture and the local details of flow fields are desired. Although the implementation of the extraction algorithm is application dependent, visualization is simple and efficient. Further work will include refinement of the SGDM model and improvement of eddy data management so eddies can be retrieved, for visualization, by their locations in time and space, or by their properties.

References

[Ber83] R. L. Berstein. "Eddy Structure of the North Pacific Ocean," In Eddies in Marine Science, A. R. Robinson, (Ed.), Springer-Verlag, New York, pp.158-166.

[CMB94] Roger Crawfis, Nelson Max, and Barry Becker. "Vector Field Visualization," IEEE Computer Graphics and Applications, Vol. 14, No. 5, Sept. 1994, pp.50-56.

[HH91] James L. Helman and Lambertus Hesselink. "Visualizing Vector Field Topology in Fluid Flows," IEEE Computer Graphics and Applications, Vol. 11, No.3, May 1991.

[HPvW94] Lambertus Hesselink, Frits H. Post, and Jarke J. van Wijk. "Research Issues in Vector and Tensor Field Visualization," IEEE Computer Graphics and Applications, Vol. 14, No. 2, March 1994, pp. 76-79.

[HP93] A. Hin and F. Post. "Visualization of Turbulent Flow with Particles," IEEE Visualization '93 Proceedings, San Jose, CA, Oct. 1993, pp.46-52.

[HWSM92] Harley E. Hurlburt, Alan J. Wallcraft, Ziv Sirkes, and E. Joseph Metzger. "Modeling of the Global and Pacific Oceans: On the Path to Eddy-Resolving Ocean Prediction," Oceanography, Vol. 5, No. 1, pp.9-18.

[JM95] Andreas Johannsen and Robert J. Moorhead II. "AGP: Ocean Model Flow Visualization," IEEE Computer Graphics and Applications, Vol. 15, No. 4, July 1995.

[Ken94] Michael J. Kennish. "Physical Oceanography," Practical Handbook of Marine Science, 2nd Edition, CRC Press, pp.3-10.

[MBC93] N. Max, B. Becker, and R. Crawfis. "Flow Volumes for Interactive Vector Field Visualization," IEEE Visualization '93 Proceedings, San Jose, CA, Oct. 1993.

[MCW92] N. Max, R. Crawfis, and D. Williams. "Visualizing Wind Velocities by Advecting Cloud Textures," IEEE Visualization '92 Proceedings, Boston, MA, Oct. 1992.

[MBL+91] James V. Miller, David E. Breen, William E. Lorensen, Robert M O'Bara and Michael J. Wozny. "Geometrically Deformed Models: A Method for Extracting Closed Geometric Models from Volume Data," Computer Graphics, Vol. 25, No. 4, July 1991, pp.217-226.

[Rob83] Allan R. Robinson (Ed.). "Overview and Summary of Eddy Science," Eddies in Marine Science, Springer-Verlag, New York, 1983, pp.3-15.

[SJ92] Chiao-Fe Shu and Ramesh C. Jain. "Vector Field Analysis for Oriented Patterns," IEEE Conf. on Computer Vision and Pattern Recognition, June 1992, pp.673-676.

[Wal91] A. J. Wallcraft. "The Navy Layered Ocean Model Users Guide," Naval Oceanographic and Atmospheric Research Laboratory, NOARL Report 35, Dec. 1991.

[vWHdLP94] Jarke J. van Wijk, Andrea J. S. Hin, Willem C. de Leeuw, Frits H. Post. "Three Ways to Show 3D Fluid Flow," IEEE Computer Graphics and Applications, Vol. 14, No. 5, Sept. 1994, pp.33-39.

Research Advisor: Dr. Robert J. Moorhead, NSF Engineering Research Center, Mississippi State University.

Michael S. Baer IV
B.S. Program, College of Science and Technology
University of Southern Mississippi

Project #1 Title: CAST Model Evaluation System (CMES) Documentation

Objectives: To update HTML documentation for the CMES.

Approach: After getting a complete understanding of the CMES, the latest in HTML editing tools will be used to update the Hypertext interactive help system. This system will also use "image mapping." This use of image mapping will allow the user to interact with a copy of the CMES GUI. To develop these image maps, "snapshots" of all the GUI screens must be created and a special image mapping tool will be used to create the image maps.

Results: The hypertext documentation was updated to correspond to current HTML standards. The "image maps" were added to the documentation. This added functionality to the documentation and made it much more user friendly.

Research Advisor: Mr. Ramesh Krishnamagaru, Center for Air Sea Technology, Mississippi State University.

****

Project #2 Title: CAST Applications Program Interface (API) for IDBMS

Objectives: Create an API for IDBMS. This API will allow users to create programs using the C or Fortran languages that will be able to interact with the IDBMS as implemented on the Oracle Database.

Approach: After a clear understanding of the IDBMS has been established, an API will be developed. The API will be written in C using the Oracles Pro*C package to interact with the database. A Fortran interface will also be added to the API.

Results: A clear understanding of the IDBMS was developed. An API was developed using Pro*C that provides a C and a Fortran interface to the IDBMS.

Research Advisor: Mr. Ramesh Krishnamagaru, Center for Air Sea Technology, Mississippi State University.

****

Project #3 Title: Regional Site Prototype for Master Environmental Library (MEL)

Objectives: To create a prototype regional site for MEL. This prototype will allow users to browse and retrieve environmental data stored at CAST in the NEONS database using a standard WWW browser. The data can be retrieved in a raw (ASCII) format or visualizations, and animations of the data can be sent to the user.

Approach: An understanding of MEL and it's objectives will be established. Other browsers implemented in HTML will be studied. After this is accomplished, a design for the prototype will be developed and reviewed. When the design document has been approved, a prototype will be developed in HTML using the common gateway interface to connect the HTML document with the database.

Results: A prototype browser, based closely on the existing NOAA/PMEL browser, was developed. This browser allows users to browse and retrieve data from the NEONS database at CAST. The data can be retrieved in a raw (ASCII) format or as visualizations.

Research Advisor: Mr. Valentine Ananatharaj, Center for Air Sea Technology, Mississippi State University.

****

Project #4 Title: Creation of Various Graphic Products

Objectives: To be able to efficiently and easily create graphic products for a variety of different purposes.

Approach: Obtain a public domain copy of the Generic Mapping Tools (GMT) from the University of Hawaii. Become familiar with the syntax and paradigm of the GMT package. Learn about subsetting data, colormap editing, contouring, vector plots, 3D surfaces, color images, interpolation of data and various map projections.

Results: CAST now has the ability to quickly and easily generate a variety of informative and intuitive graphic products.

Research Advisor: Mr. Valentine Ananatharaj, Center for Air Sea Technology, Mississippi State University.

Ann Lott
B.A. And B.F.A. Program
William Carey College

Project Title: Objective Feature Identification: A Review

Objective: To recreate, replicate, and convert graphs from photo copies to computer usage for CAST technical reporting. Also, to explore and learn how to create computer graphics using the PowerMac PC7100/66AV with Adobe Photoshop 3.0 and Canvas 2.5 software.

Approach: A photocopy of each graph and chart image was scanned and then imported into the Adobe Photoshop and Canvas software. Replicating, cloning, or recreating was necessary for legible quality of each image printed and converted into different accessible files. Each image was converted into four different file formats: .gif, .pict, .pt, and .tiff.

Art teachers are aware of the impact emerging technologies have made on education, and are faced with the challenge of using the computer effectively and appropriately in the teaching and learning environments. The computer is a medium with its own built-in agenda that encourages the richness of artistic exploration associating with other art mediums. Software developers have linked the control of the computer to more accessible and familiar terms: paint, draw, cut and paste, erase, smudge, or color. Computer-based art has a particular somewhat long-term interaction. The media provides a more obvious merging and blending of all facets of artwork and production. It also brings a unique awareness of the interplay between the personal, social, and scientific/technological spheres.

Results: Seven graphs were completed and each was converted into .gif, .pict, .ps, and .tiff files. The opportunity to participate in this project has resulted in my growth of a new language, and I have developed new skills in educational and artistic computing.

Project Advisors: Mr. J.H. Corbin and Dr. Harsh Anand, Center for Air Sea Technology, Mississippi State University

DISTRIBUTION LIST

1. Scientific Officer (Code 1242)
   Dr. Tom Curtin (3 Copies)
   Office of Naval Research
   800 N. Quincy Street
   Arlington, VA 22217-5000

2. Office of Naval Research
   800 N. Quincy Street
   Arlington, VA 22217-5000
   -Dr. Emmanuel Fiaderio
   -Dr. Alan Weinstein

3. Defense Technical Information Center
   Building 5, Cameron Station (2 Copies)
   Alexandria, VA 22304-6145

4. Administrative Grants Officer
   ONR Regional Office
   101 Marietta Street-Suite 2805
   Atlanta, GA 30303

5. Director, Naval Research Laboratory
   Attention: Code 2627
   Washington, DC 20375

6. Technical Director
   Oceanographer of the Navy
   U.S. Naval Observatory
   Washington, DC 20392

7. Director, Ocean Dynamics and
   Prediction Branch
   Naval Research Laboratory
   Stennis Space Center, MS 39529

8. Technical Director
   Naval Research Laboratory
   Monterey, CA 93943-5006

9. Naval Oceanographic Office
   Stennis Space Center, MS 39529
   -Mr. Landry Bernard
   -Dr. Martha Head

10. Chairman, Oceanography Department
    Naval Postgraduate School
    Monterey, CA 93943

11. Technical Director, Fleet Numerical
    Meteorology and Oceanography Center
    Monterey, CA 93943-5000

12. Space and Naval Warfare Systems
    Command (PMW175-3B)
    2451 Crystal Drive
    Arlington, VA 22245-5200
    -CDR David Markham
    -Dr. Edward Harrison

13. Mr. Alberto Mestas-Nunez
    College of Oceanic and Atm Sciences
    Oregon State University
    Corvallis, Or 97331-5503

14. MSU Office of Research
    Mississippi State, MS 39762
    -Dr. Ralph Powe
    -Dr. Melvin Ray

15. William Carey College
    498 Tuscan Avenue
    Hattiesburg, MS 39401-5499
    Biloxi, MS
    -Ms. Maria Lindberg
    -Mr. Shannon Ellis
    -Ms. Ann Lott

16. Ms. Debbie Baer
    WLOX-TV 13
    P.O. Box 4596
    Biloxi, MS 39535-4596

17. Center for Air Sea Technology
    Mississippi State University
    Building 1103 - Room 233
    Stennis Space Center, MS 39529-6000
    -Mr. Valentine Anantharaj
    -Mr. Clifton Abbott
    -Mr. Michael Baer
    -Mr. Billy Chambless
    -Mr. Ed Clark
    -Mr. Jim Corbin
    -Mr. Steve Foster
    -Mr. Ramesh Krishnamagaru
    -Mr. Steven Payne
    -Dr. Lanny Yeske
    -Dr. Zhifan Zhu
    -Mr. Ognen Zografski

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. Agency Use Only *(Leave blank).*

2. Report Date. 30 September 1995

3. Report Type and Dates Covered. Technical Note 1 Oct 1994-30 Sept 1995

4. Title and Subtitle.

FY1995 STUDENT RESEARCH PROJECTS

5. Funding Numbers.

Program Element No.

Project No.

Task No.

Accession No.

6. Author(s). C. Abbott, B. Chambless, S. Payne, S. Ellis, E.M. Lindberg, A. Mestaz-Nunez, E. Clark, O. Zografski, R. Krishnamagaru, V. Anantharaj, J. Corbin, D. Dietrich, C. Cesario, Z. Zhu, R. Moorhead, M. Baer, A. Lott, H. Anand and L. Yeske (Editor)

7. Performing Organization Name(s) and Address(es).

Mississippi State University
Center for Air Sea Technology
Building 1103, Room 233
Stennis Space Center, MS 39529-6000

8. Performing Organization Report Number.

CAST Technical Note 01-95

9. Sponsoring/Monitoring Agency Name(s) and Address(es).

Office of Naval Research (Code 1242)
800 North Quincy Street
Arlington, VA 22217

Naval Research Laboratory, Stennis Space Center, MS 39529

10. Sponsoring/Monitoring Agency Report Number.

CAST Technical Note 01-95

11. Supplementary Notes.

Research performed under ONR Grants N00014-95-0186/0218/0293/0303/0068; NRL Contract N00014-92-C-6032, and NASA NAS13-564 Delivery Order 11.

12a. Distribution/Availability Statement.

Approved for public release; distribution is unlimited

12b. Distribution Code.

13. Abstract *(Maximum 200 words).*

Numerous FY1995 student research projects were sponsored by Mississippi State University Center for Air Sea Technology. This technical note describes these projects which include the CAST Model Evaluation System on ISIS, the Master Environmental Library, Relational Database Management Systems, Oracle Database Transfers, Creation of Application Programming Interfaces, Manipulating Satellite Altimetry Data, Relocatable Modeling, Graphic Designs in Environmental Large-Scale Variability in the South Pacific, NEONS Modifications, HTML Application, Extracting and Visualizing Ocean Eddies, CAST Model Evaluation System Documentation, the Creation of Graphics Products, and Object-Feature Identification.

14. Subject Terms.

(U) Technical Note (U) Student (U) Research (U) CAST

15. Number of Pages. 38

16. Price Code.

17. Security Classification of Report.	18. Security Classification of This Page.	19. Security Classification of Abstract.	20. Limitation of Abstract.
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	